

Automatic Feature Description of Endometrioma in Ultrasonic Images of the Ovary

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Abstract: Endometriosis cyst or endometrium is commonly found in women with subfertility. Traditionally, medical technologies fail to detect the disease automatically and it is fully dependent on the doctors to determine the peritoneal disease where it may lead to inaccurate findings. A method of assessment may give more accurate detection without the need for surgical procedure, especially in monitoring disease recurrence. This will avoid surgical risk and will not delay the management. In this study, the feature description is developed using pattern recognition, involving image processing techniques; the ultrasonic images is used as input in which the region of interest of images, image segmentation, feature extraction are studied

Keywords: Endometrioma cysts, ultra-sonographic, pattern recognition, image processing technique, ultrasound scan.

1. Introduction

Endometrioma cyst is a cyst in the ovary filled with old blood, occurs due to endometriosis in which the endometrium bleeds during the menstrual cycle, grows and enlarges inside the ovaries. It forms an ovarian cyst filled with chocolate like material [1-2]. It can be detected by using ultrasound where the image is darker than other regions. A sort of edge of an elliptical geometric shape can be traced. Endometrioma can be dangerous and harmful if no treatment is done as the cyst may grow. It is not unusual for endometrioma to grow to 18cm-20cm (7-8 inches) [1]. Endometrioma and dermoid cyst will usually rupture if there is a severe blow to the pelvis. It is unlikely that they will rupture spontaneously. If they do rupture, surgery is performed to flush the pelvis with a saline solution (distilled water containing salt), to irrigate and wash away the contents of the cyst [3].

However, gynecologists need to do the clinical diagnosis of the the cyst manually from the ultrasonic image, but quality and image interpretation is highly depending on the skill of the gynecologist. This may lead to inaccurate finding and can be dangerous and risk to the patient. It is hard for the doctors to determine the endometrioma from the ultrasound image as the image of endometrioma is quite similar with normal follicle, Thus, automated software are proposed by using Matlab Software to help them in order to detect the cyst accurately without the need for surgical procedure, especially in monitoring disease recurrence.

Different methods have been developed in the literature on the identification of the ovarian cysts. Potocnik and Zazula worked on a method based on optimal thresholding [3] and then upgraded by using active contour technique [4] for the segmentation of follicles. Cigale and Zazula implemented the neural network approach for the segmentation [3]. Others use the multiscale morphological method for the denoising, contrast enhancement [5], and horizontal and vertical thresholding for cysts segmentation [6].

The method presented in this paper consist of applying a multi – scale morphological process for noise reduction and for contrast enhancement, followed by segmentation and detection. The classification process is applied on the image to measure and analyze the size of the cyst based on the minor axis, major axis, parameter and area.

2. Experiment set up

Figure 1 shows the feature description method and MATLAB is used as a platform of processing the images. Previous studies also used quite similar techniques to process the image in order to describe the features [7-10].

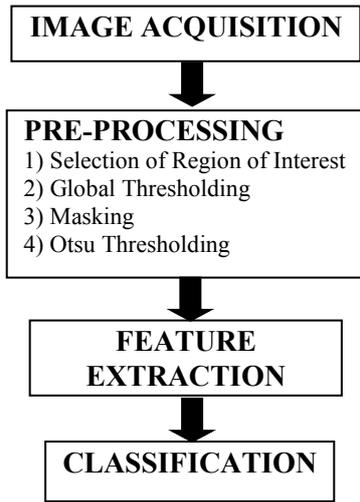


Fig. 1 Feature description method

Image Acquisition

The images are taken from Dr Mukhri Hamdan, University Malaya Medical Centre (UMMC). Figure 2 shows the original image of the endometrioma.



Fig. 2 Original Image of Endometrioma

Image Pre-processing

The image is converted into grayscale, cropped to select the region of interest. After that, global thresholding is applied on the cropped image before masking it global thresholding. Lastly, Otsu thresholding is applied to that image. The techniques of image pre-processing are: First, original image is cropped (Figure 3(a)) to define the region of interest. This image then is applied to global thresholding to get black and white image. Global Thresholding is used by visual inspection of the image histogram. The result of global thresholding is shown as Figure 3(b). Next, masking is applied by subtracting image from global thresholding and cropped image. The result of masking is shown in Figure 3(c). Last step of pre-processing involves Otsu Thresholding in which the method is applied on the subtracted image. Otsu's thresholding is used to automatically perform clustering-image thresholding, or the reduction of a gray level image to binary image. The image is shown in Figure 3(d).

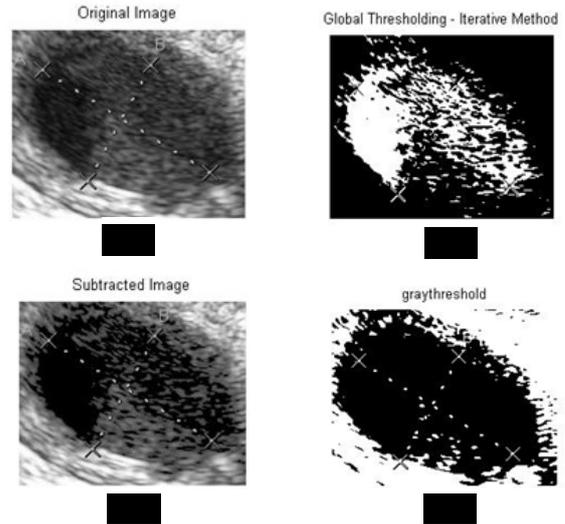


Fig. 3 (a) Cropped original image; Image pre-processing method: (b) Global thresholding-Iterative Method, (c) Subtracted Image and (d) Gray Threshold using Otsu Thresholding.

3. Results and Discussion

Manual measurement is measured by a specialist based on ultrasonic image to get the geometric measurement of endometrioma. The geometric measurements that are being measured are major and minor axis length, area, perimeter, and compactness. The manual measurement is compared with automatically measurement using MATLAB as shown in Table 1.

Table 1 Manual Measurement of endometrioma

| Measurement | Manual (mm) | Automatic (pixel) |
|-------------------|-------------|-------------------|
| Major Axis Length | 13.4 | 196 |
| Minor Axis Length | 9.0 | 112 |
| Area | 378.9 | 16790 |
| Perimeter | 120.6 | 678 |
| Compactness | 0.327 | 0.459 |

However, the unit of manual measurements are in mm, compared to automatic measurement in pixel. Both mm and pixel unit cannot be directly compared. Thus relative (*R*) is calculated to eliminate both pixels and mm unit. It is expressed as a ratio in a unitless number, shown as in equation (1):

$$R = \frac{\text{Major Axis Length}}{\text{Minor Axis Length}} \tag{1}$$

R are 1.489 and 1.751 for manual and automatic measurement respectively with no unit, so both values are valid to be compared. It shows that the automatic measurement can be used to assist the manual

measurement. The properties of *R* and Compactness of automatic measurement is calculated using relative error and percent error based on manual measurement shown as equations below.

$$\text{Relative Error} = \frac{|Manual\ Measurement - Automatic\ Measurement|}{Manual\ Measurement} \tag{2}$$

$$\text{Percentage Error (\%)} = \text{Relative Error} \times 100\% \tag{3}$$

The percentage error is the relative error expressed in %. Table 2 shows the error measured of *R*, and Compactness. It shows that automatic measurement can be used to reduce the time consuming of the manual measurement because the relative error is small and the compactness is still acceptable.

Table 2 Error Measured of *R* and Compactness

| | <i>R</i> | Compactness |
|----------------------|----------|-------------|
| Relative Error | 0.176 | 0.404 |
| Percentage Error (%) | 17.56 | 40.36 |

4. Summary

This work presents the elaboration of an automated technique that can be used to describe the endometrioma cysts in ovarian ultrasound images and of differentiating between the two types of cysts. This detection and classification has been made based on the geometrical features of the cysts texture. For future work, the technique can be improved to generalize the work on all ovarian cyst types, including Dermoid cysts, while maintaining the classification accuracy. Increasing the database size and the number of images would therefore be necessary for a better evaluation of the solution.

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